Northern Territory Naturalist (2015) 26: 44–55 Research Article

Helminth parasites of the introduced Asian House Gecko (*Hemidactylus frenatus*) (Gekkonidae), in the Northern Territory, Australia

Diane P. Barton

School of Tropical Biology,
James Cook University, Townsville, QLD 4811, Australia.
Current address: Natural Sciences, Museum and Art Gallery of the Northern Territory, GPO Box 4646, Darwin, NT 0801, Australia.
Email: di.barton@nt.gov.au

Abstract

This is the first report of helminths (i.e. gastrointestinal parasitic 'worms') infecting the invasive Asian House Gecko (*Hemidactylus frenatus*) in Australia. Baseline infection data are presented, but the need for more research, especially on sympatric native gekkonid species, to determine whether any of the helminths are capable of being transferred to native lizards, is highlighted. Geckos were collected from areas of mainland Northern Territory and associated offshore islands, as well as Christmas and Cocos Islands. A total of six helminth species were found: *Paradistomum* sp. (Platyhelminthes: Digenea: Dicrocoeliidae); *Oochoristica* sp. (Platyhelminthes: Cestoda: Linstowiidae); *Spauligodon hemidactylus* (Nematoda: Pharyngodonidae); *Maxvachonia* sp. (Nematoda: Cosmocercidae); a larval nematode; and an adult acanthocephalan. *Spauligodon hemidactylus*, which is reported here from Australia for the first time, was the most commonly detected species, being found in 24% of geckos. A table listing the helminth records for *Hemidactylus frenatus* in the Australasian, Asian and Pacific regions is provided.

Introduction

The Asian House Gecko (*Hemidactylus frenatus*) (Figure 1), is widespread in tropical and subtropical regions of the world. Within Australia, it has been introduced and presently occurs throughout the Northern Territory, as well as locations along the eastern coast of Queensland and the northern coast of New South Wales (McKay *et al.* 2009).

Many studies have documented helminths (i.e. intestinal parasitic 'worms') in *Hemidactylus frenatus* from locations outside Australia, including Southeast Asia (Saehoong & Wongsawad 1997; Matsuo & Oku 2002; Goldberg, Bursey & Telford 2005; Goldberg *et al.* 2011), Papua New Guinea (Goldberg *et al.* 2010) and the Pacific Islands (Hanley *et al.* 1995; Hanley *et al.* 1998). However, so far there have been no

studies of helminth infections in introduced populations of *H. frenatus* in Australia. Hoskin (2011) identified the need for more research on the parasites of *H. frenatus* in this country, especially in relation to their potential impact upon native reptilian hosts (as reiterated by Vanderduys & Kutt 2012).

This study assessed the helminth parasites in specimens of *Hemidactylus frenatus* from the collection of the Museum and Art Gallery of the Northern Territory. These gecko specimens were also host to adult and larval pentastome parasites, as reported in Barton (2007). This study documents the occurrence of a variety of helminth infections in Northern Territory populations of *H. frenatus*.

Methods

Since 1964, *Hemidactylus frenatus* specimens have been collected by staff of the Museum and Art Gallery of the Northern Territory (MAGNT) on an opportunistic basis from throughout the Northern Territory, and from the islands off northern Australia. Geckos were preserved in 70% ethanol as part of the Museum's wet collection.

Dissection of the geckos took place in April 2002. Their internal organs were removed for inspection. The intestinal tract was opened along its length; the gall bladder was also opened but the liver was not examined. All helminths recovered were counted (except cestodes, which were often fragmented and were just noted as present or absent) and preserved in 70% ethanol. Specimens were cleared in glycerol for examination and identification. The low numbers of individuals recovered and the initial fixation of the helminths *in situ* have made identification to species level difficult for most of the helminths recovered. Parasite terminology used here follows Bush *et al.* (1997).

Figure 1. Adult Asian House Gecko (*Hemidactylus frenatus*), Darwin, Northern Territory. (Diane P. Barton)

Results

A total of 72 *Hemidactylus frenatus* (average snout-vent length 46 mm; range 34–57 mm) were dissected from various locations throughout the Northern Territory and offshore islands (Table 1). Due to the opportunistic nature of gecko collection, low numbers of individuals were collected from most locations. Thus, the locations have been combined into the geographical areas of the Northern Territory mainland and Northern Territory offshore islands (as were presented in Barton 2007). Only one gecko was available from each of Christmas and Cocos Islands.

Five types of helminths were recovered from the intestinal system – adult nematodes *Spauligodon hemidactylus* (Pharyngodonidae) (Figure 2) and *Maxvachonia* sp. (Cosmocercidae), a larval nematode, a cestode (*Oochoristica* sp. (Listowiidae)), and an acanthocephalan. The larval nematode and the acanthocephalan could not be identified.

Specimens of the digenean, *Paradistomum* sp. (Dicrocoeliidae), were also recovered from the gall bladder of eight geckos from the Northern Territory mainland. It is most likely that it is *P. geckonum*, which has been reported from *H. frenatus* in a number of locations (see Table 2), but, despite the overall body measurements and appearance overlapping, the poor quality of the specimens collected did not allow for an accurate species identification. Infections of *P. geckonum* in the gall bladder have

Figure 2. Adult female *Spauligodon hemidactylus* from rectum of Asian House Gecko (*Hemidactylus frenatus*) from Darwin, Northern Territory. The head with the pharynx visible through the transparent cuticle is on the right and the tail with its long cuticular spine is on the left. Scale bar = 1 mm. (Adam Bourke)

Table 1. Collection areas, number of *Hemidactylus frenatus* examined (N) from each area, and infection parameters of helminths collected from geckos dissected from the MAGNT collection. The geckos from Christmas Island and Cocos Island have been excluded from the table. Site of infection is presented in parentheses. Data presented as number of geckos infected (prevalence); mean intensity of infection. *Oochoristica* sp. was only recorded as present/absent.

Geographical Area	N	*Paradistomum* sp. (Gall Bladder)	*Spauligodon hemidactylus* (Rectum)	*Maxvachonia* sp. (Intestine)	*Oochoristica* sp. (Intestine)	Nematode Larva (Stomach wall)	*Acanthocephala* sp. (Intestine)
NT Mainland	52	8 (15.4%); 1.6	13 (25.0%); 4.1	2 (3.8%); 1	6 (11.5%)		1 (1.9%); 1
NT Islands	18		4 (22.2%); 2		1 (5.6%)	1 (5.6%); 1	
Total	70	8 (11.4%); 1.6	17 (24.3%); 3.5	2 (2.9%); 1	7 (10.0%)	1 (1.4%); 1	1 (1.4%); 1

Table 2. Literature records of helminth parasites obtained from *Hemidactylus frenatus* listed by area.

Helminth	PNG	Asia	Pacific Islands	References*
Nematoda				
Spauligodon hemidactylus	PNG	Indonesia, Sri Lanka, Philippines, Thailand, Borneo	American Samoa, Western Samoa, Tahiti, Tuamotu, Belau, Fiji, Solomon Islands, Vanuatu, Marshall Islands, Guam, Hawaii, Palau Mariana Islands	Hanley *et al.* 1995 Bursey & Goldberg 1996 Goldberg *et al.* 1998 Goldberg & Bursey 2002 Matsuo & Oku 2002 Goldberg, Bursey & Telford 2005 Goldberg *et al.* 2010 Goldberg *et al.* 2011
Parapharyngodon maplestoni		Thailand, Borneo, Philippines	Belau, various locations	Hanley *et al.* 1995 Goldberg & Bursey 2002
Parapharyngodon sp.		Thailand, Borneo, Philippines	Various locations	Hanley *et al.* 1995
Pharyngodon kartana			Various locations	Hanley *et al.* 1995
Pharyngodon sp.		Thailand		Sachoong & Wongsawad 1997
Skrjabinelazia machidai			Mariana Islands (Guam), various locations	Hanley *et al.* 1995 Goldberg *et al.* 1998
Skrjabinodon dossae		Philippines		Schmidt & Kuntz 1972
Strongyloides sp.		Thailand, Borneo, Philippines	Various locations	Hanley *et al.* 1995
Hedruris hanleyae			Tahiti	Goldberg & Bursey 2002
Hedruris sp.			Various locations	Hanley *et al.* 1995
Ascaridia frenatusi		India		Jehan 1971
Thubunaea hemidactylae		Vietnam		Oshmarin & Demshin 1972

Continued next page.

Table 2. Continued.

Helminth	PNG	Asia	Pacific Islands	References*
Physocephalus sp.			Various locations	Hanley *et al.* 1995
Acuariid gen. sp.	PNG			Goldberg *et al.* 2010
Nematode (?Oxyurid)			Hawaii	Brown *et al.*, 1995
Physaloptera sp. (Larva)			Solomon Islands, various locations	Hanley *et al.* 1995 Goldberg & Bursey, 2002
Abbreviata sp. (Larva)	PNG		Various locations	Hanley *et al.* 1995 Goldberg *et al.* 2010
Ascarops sp. (Larva)			Fiji , various locations	Hanley *et al.* 1995 Goldberg & Bursey, 2002
Digenea				
Paradistomum geckonum (syn. *P. gregarium*)		Indonesia, Thailand, Philippines, Laos		Killick & Beverley-Burton 1982 Scholz & Ditrich 1991 Sachoong & Wongsawad 1997 Matsuo & Oku 2002 Goldberg, Bursey & Telford 2005
Postorchigenes ovatus		Indonesia, Thailand, Borneo, Philippines		Killick & Beverley-Burton 1982 Hanley *et al.* 1995 Matsuo & Oku 2002 Goldberg, Bursey & Telford 2005
Postorchigenes majeedi		Laos		Scholz & Ditrich, 1991
Postorochigenes sp.		Thailand		Sachoong & Wongsawad 1997
Liver fluke (?*Platynosomum fastosum* metacercaria)			Hawaii	Brown *et al.*, 1995
Mesocoelium monas		Indonesia, Sri Lanka		Goldberg *et al.* 2011

Continued next page.

Table 2. Continued.

Helminth	PNG	Asia	Pacific Islands	References*
Mesocoelium sociale		Indonesia		Killick & Beverley-Burton, 1982
Cestoda				
Oochoristica javaensis	PNG	Indonesia, Thailand, Borneo, Philippines	Solomon Islands, Marshall Islands	Kennedy *et al.*, 1982 Hanley *et al.* 1995 Goldberg & Bursey 2002 Goldberg, Bursey & Telford 2005 Goldberg *et al.* 2010
Oochoristica sp.		Thailand	Hawaii, various locations	Brown *et al.* 1995 Hanley *et al.* 1995 Sachoong & Wongsawad 1997
Cylindrotaenia allisonae			Belau, Fiji	Goldberg & Bursey 2002
Cylindrotaenia sp.			Various locations	Hanley *et al.* 1995
Acanthocephala				
Pseudoacanthocephalus nguyenthileae		Vietnam		Amin *et al.* 2008
Sphaerechinorhynchus macropisthospinus		Thailand		Amin *et al.* 1998
Cystacanth Type I		Thailand		Sachoong & Wongsawad 1997

*Hanley *et al.* 1995 listed various islands throughout the Pacific Ocean as locations where *H. frenatus* were collected in sympatry with *Lepidodactylus lugubris*, without differentiating which locations contained geckoes infected with particular helminth species.

^Full text of manuscript unavailable; information taken from abstract.

been identified by Kennedy *et al.* (1987) as an overflow from a heavily infected liver. The liver was not opened in this study. Thus, the data presented here for infection levels of *Paradistomum* sp. in the gall bladder of the host may not be a true indication of infection levels for this species and these results need to be treated with caution.

As only one gecko was available from each of Christmas and Cocos Islands, of which only the former was infected with a single *Spauligodon hemidactylus*, these geckoes have been excluded from all further analyses.

Spauligodon hemidactylus (Figure 2) was the most commonly encountered helminth, occurring in 17 geckos (24.3%), with a mean intensity of 3.5 nematodes per infected gecko. *Paradistomum* sp. was the next most commonly encountered helminth (eight individuals, 11.4% prevalence; mean intensity of 1.6), followed by *Oochoristica* sp. (prevalence of 10.0%). *Maxvachonia* sp. (prevalence 2.9%, mean intensity of 1), the larval nematode and the adult acanthocephalan (both only encountered in one host individual) were too rarely encountered to derive meaningful infection statistics.

For the intestinal helminths only, a total of 24 of the geckos were infected with at least one helminth individual (34.3%). Of the geckos that were infected, 22 were only infected with one species of helminth (91.7%), and two geckos were infected with two species of helminth (8.3%). For those geckos only infected with one species of helminth, 13 were infected with *S. hemidactylus* (54.2%).

Discussion

This is the first record of helminth parasites infecting *Hemidactylus frenatus* in Australia. Recent studies (Hoskin 2011; Vanderduys & Kutt 2012) highlighted the need for research into the parasites of *H. frenatus* and sympatric native geckos to determine if *H. frenatus* is having any parasite-mediated deleterious effects on native geckos.

Lymbery *et al.* (2014) detailed the problems with determining whether parasites found in invading hosts (called co-introduced parasites) have actually been able to transfer successfully to another species of host (i.e. to become a co-invader). This study provides some baseline data on helminth parasites infecting *H. frenatus* in the Northern Territory. However, this study was limited by the nature of collection of the animals. Whether the gecko individuals collected were recently-arrived animals or the offspring of previously arrived animals (i.e. a successful invader) remains unknown. Thus, whether the helminths they contain are also successful invaders is also unknown. Further study is required to determine whether the helminths within *H. frenatus* are able to transmit to other hosts, be they either other *H. frenatus* individuals or individuals of other species. The helminth fauna of many native lizards in northern Australia is poorly known (see Goldberg & Bursey 2012) which will make determination of transfer difficult.

The potential impacts of any of the parasites recorded in *H. frenatus* in this study on the health of their host, or the health of any subsequent host species that they may

infect, remains unknown. Few helminths have been incriminated as significant pathogens of lizards, especially of wild-caught specimens (Jacobson 2007).

There are many records of helminth infection in *H. frenatus* populations from Southeast Asia, Papua New Guinea and islands of the Pacific area, showing infections with a diverse range of parasites (Table 2). Of these records, *Spauligodon hemidactylus* is present in all locations and in all studies that have documented nematode infections. *Spauligodon hemidactylus* has also been reported from a range of gekkonid species (see Goldberg *et al.* 2011), so is obviously able to transfer easily once established. Although *Spauligodon* is well represented by many species reported from around the world, only one, *S. ovifilus* (from the diplodactylid *Lucasium stenodactylum*), has been reported from Australia (Bursey *et al.* 2005). Although both *S. ovifilus* and *S. hemidactylus* have an aspinose tail in the male, *S. hemidactylus* does not possess a copulatory spicule (Bursey, Goldberg & Kraus 2005), as for the specimens collected in this study. This is the first record of *S. hemidactylus* in Australia.

The digenean *Paradistomum geckonum* is also a successful co-invading parasite, with a wide variety of reported host species, including gekkonids, lacertids, agamids and scincids, across all locations (see Goldberg, Bursey & Fisher 2005; Goldberg *et al.* 2008; Table 2). Both Pichelin *et al.* (1999) and Goldberg and Bursey (2012) do not list *P. geckonum* as having being recorded in Australian reptiles; only *P. crucifer* has previously been reported from a few host species ranging from northern Queensland to South Australia (see Goldberg & Bursey 2012). Despite the high level of variability in measurements for species of *Paradistomum* reported in the literature (see Killick & Beverley-Burton 1982), the morphological differences between *P. crucifer* and *P. geckonum* are distinct. The specimens found in this study morphologically match the description and the overall body measurements for *P. geckonum*. However, given the wide variation in specimens of this genus reported in the literature, the poor quality of the specimens recovered were not able to provide an accurate species identification. More research needs to be conducted on *H. frenatus* in the Northern Territory to confirm the identification of the *Paradistomum* sp.

It can be assumed that both *Spauligodon hemidactylus* and *Paradistomum geckonum* are likely to become successful co-invading parasites in Australia, but further research needs to investigate whether they have been transferred to any native Australian reptiles post-introduction.

Oochoristica is a cosmopolitan genus of cestodes, with four species reported from Australian reptiles (Bursey *et al.* 1996). Identification of species of *Oochoristica* is reliant on reproductive features in mature proglottids. The poor quality of the specimens found in this study prevented specific identification.

Maxvachonia has a restricted distribution in reptiles and amphibians, primarily in the Australopapuan region (see Moravec & Sey 1990). Five species have been reported, of which *M. brygooi* and *M. chabaudi* occur in reptiles in Australia (Moravec & Sey 1990).

Maxvachonia chabaudi has also been reported from various lizards throughout the Pacific islands (Goldberg, Bursey & Fisher 2005). Identification of species of *Maxvachonia* is reliant on the presence of male specimens (see Mawson 1972), of which none were found in this study. Therefore, specific identification was not attempted.

In a comparison of the parasite fauna of native endemic and 'invading' geckos, including *Hemidactylue frenatus*, in Papua New Guinea, Goldberg *et al.* (2010) found that the majority of helminths reported were largely generalists with low host specificity. This has led to the suggestion that helminths of lizards have a "pan-oceanic" distribution, from Papua New Guinea north and northeast across the Pacific (see Goldberg *et al.* 2014). Of the records summarised by Goldberg and Bursey (2012) for lizards in Australia, various helminths were found to occur in a variety of hosts; for example *Parapharyngodon kartana* has been recorded in representatives across four families (Gekkonidae, Diplodactylidae, Agamidae and Scincidae). As further research documents the helminths of lizards, especially those sympatric with *H. frenatus*, it is likely that the pattern of generalist helminths and the similarity of lizard helminth faunas will be reported.

Acknowledgements

This work was partly funded by the Australian Geographic Society. Thanks are accorded to Paul Horner and Gavin Dally (MAGNT) for access to the gecko specimens for dissection. Also, many thanks to Conrad Hoskin for his in-depth and critical review of this manuscript. Adam Bourke kindly photographed a specimen of *Spauligodon hemidactylus* for this article.

References

Amin O.M., Ha N.V. and Heckmann R.A. (2008) New and already known acanthocephalans from amphibians and reptiles in Vietnam, with keys to the species of *Pseudoacanthocephalus* Petrochenko, 1956 (Echinorhynchidae) and *Sphaerechinorhynchus* Johnston and Deland, 1929 (Plagiorhynchidae). *Journal of Parasitology* 94, 181–189.

Amin O.M. *et al.* (1998) *Sphaerechinorhynchus macropisthospinus* sp. n. (Acanthocephala: Plagiorhynchidae) from lizards, frogs, and fish in Thailand. *Journal of the Helminthological Society of Washington* 65, 174–478.

Barton D.P. (2007) Pentastomid parasites of the introduced Asian house gecko, *Hemidactylus frenatus* (Gekkonidae), in Australia. *Comparative Parasitology* 74, 254–259.

Brown S.G., Kwan S. and Shero S. (1995) The parasitic theory of sexual reproduction: parasitism in unisexual and bisexual geckos. *Proceedings of the Royal Society of London B.* 260, 317–320.

Bursey C.R. and Goldberg S.R. (1996) *Spauligodon hemidactylus* n. sp. (Nematoda: Pharyngodonidae) from *Hemidactylus frenatus* (Reptilia: Gekkonidae) from Oceania. *Journal of Parasitology* 82, 299–301.

Bursey C.R., Goldberg S.R. and Kraus F. (2005) New species of *Spauligodon* (Nematoda: Pharyngodonidae) in *Lepidodactylus novaeguineae* (Sauria: Gekkonidae) from Papua New Guinea. *Journal of Parasitology* 91, 324–328.

Bursey C.R., Goldberg S.R and Woolery D.N. (1996) *Oochoristica piankai* sp. n. (Cestoda: Linstowiidae) and other helminths of *Moloch horridus* (Sauria: Agamidae) from Australia. *Journal of the Helminthological Society of Washington* 63, 215–221.

Bush A.O., Lafferty K.D., Lotz J.M. and Shostak A.W. (1997) Parasitology meets ecology on its own terms: Margolis *et al.* revisited. *Journal of Parasitology* 83, 575–583.

Goldberg S.R. and Bursey C.R. (2002) Gastrointestinal helminths of seven gekkonid lizard species (Sauria: Gekkonidae) from Oceania. *Journal of Natural History* 36, 2249–2264.

Goldberg S.R. and Bursey C.R. (2012) Intestinal helminths in nine species of endemic Australian lizards, *Lophognathus longirostris* (Agamidae), *Heteronotia binoei* and *Lucasium stenodactylum* (Gekkonidae), *Ctenotus grandis, Ctenotus helenae, Cyclodomorphus branchialis, Egernia depressa, Eremiascincus richardsonii, Morethia butleri*, and *Morethia lineoocellata* (Scincidae), with a review of Australian lizard helminths. *Comparative Parasitology* 79, 247–268.

Goldberg S.R. *et al.* (2011) Helminths from 9 species of geckos (Squamata: Gekkkonidae) from Sri Lanka. *Comparative Parasitology* 78, 359–366.

Goldberg S.R., Bursey C.R. and Cheam H. (1998) Gastrointestinal helminths of four gekkonid lizards, *Gehyra mutilata, Gehyra oceanica, Hemidactylus frenatus* and *Lepidodactylus lugubris* from the Mariana Islands, Micronesia. *Journal of Parasitology* 84, 1295–1298.

Goldberg S.R., Bursey C.R. and Fisher R.N. (2005) Helminth records from eleven species of *Emoia* (Sauria: Scincidae) from Oceania. *Pacific Science* 59, 609–614.

Goldberg S.R., Bursey C.R., Hamilton A.M. and Austin C.C. (2014) Gastrointestinal helminths in two species of geckos, *Gekko vittatus, Gehyra oceanica*, and five species of skinks, *Caledoniscincus atropunctatus, Emoia cyanogaster, Emoia evrroman, Emoia nigra, Emoia sanfordi* (Squamata) from the Republic of Vanuatu, Oceania. *Comparative Parasitology* 81, 67–74.

Goldberg S.R., Bursey C.R. and Kraus F. (2008) Gastrointestinal helminths of eleven species of *Emoia* (Sqauamata: Scincidae) from Papua New Guinea. *Journal of Natural History* 42, 1923–1935.

Goldberg S.R., Bursey C.R. and Kraus F. (2010) Helminths of ten species of geckoes (Sqauamata: Gekkonidae) from Papua New Guinea, with comparisons between immigrant and endemic geckos. *Pacific Science* 64, 131–139.

Goldberg S.R., Bursey C.R. and Telford S.R. (2005) Metazoan endoparasites of four species of lizards, *Gehyra mutilate, Hemidactylus frenatus* (Gekkonidae), *Mabuya cumingi, Mabuya multifasciata* (Scincidae), and one species of snake, *Ramphotyphlops braminus* (Typhlopidae), from the Philippine Islands. *Comparative Parasitology* 72, 88–101.

Hanley K.A., Petren K. and Case T.J. (1998) An experimental investigation of the competitive displacement of a native gecko species by an invading gecko: no role for parasites. *Oecologia* 115, 196–205.

Hanley, K.A., Vollmer D.M. and Case T.J. (1995) The distribution and prevalence of helminths, coccidia and blood parasites in two competing species of gecko: implications for apparent competition. *Oecologia* 102, 220–229.

Hoskin C. (2011) The invasion and potential impact of the Asian House Gecko (*Hemidactylus frenatus*) in Australia. *Austral Ecology* 36, 240–251.

Jacobson E.R. (2007) Parasites and parasitic diseases of reptiles. In *Infectious Diseases and Pathology of Reptiles*. (ed. Jacobson E.R.), pp. 571–665. Taylor & Francis, Boca Raton.

Jehan M. (1971) Three nematode parasites from reptiles. *Indian Journal of Helminthology* 22, 165–172.

Kennedy M.J., Killick L.M. and Beverley-Burton M. (1987) The prevalence of *Paradistomum geckonum*, *Mesocoelium sociale*, and *Postorchigenes ovatus* (Digenea) in lizards (Sauria) from Indonesia. *Canadian Journal of Zoology* 65, 1292–1294.

Killick L.M. and Beverley-Burton M. (1982) Observations on digeneans from lizards (Sauria) in Indonesia (*Paradistomum geckonum*, *Mesocoelium sociale*, and *Postorchigenes ovatus*) with a revision of *Paradistomum* Kossack, 1910 (Digenea). *Canadian Journal of Zoology* 60, 2093–2106.

Lymbery A.J. *et al.* (2014) Co-invaders: the effects of alien parasites on native hosts. *International Journal for Parasitology: Parasites and Wildlife* 3(2), 171–177. <http://dx.doi.org/10.1016/j.ijppaw.2014.04.002> (accessed 21 July 2014).

Matsuo K., and Oku Y. (2002) Endoparasites of three species of house geckoes in Lampung, Indonesia. *Journal of Helminthology* 76, 53–57.

Mawson P.M. (1972) The nematode genus *Maxvachonia* (Oxyurata: Cosmocercidae) in Australian reptiles and frogs. *Transactions of the Royal Society of South Australia* 96, 101–108.

McKay J.L., Griffiths A.D and Crase B. (2009) Distribution and habitat use by *Hemidactylus frenatus* Duméril and Bibron (Gekkonidae) in the Northern Territory, Australia. *The Beagle, Records of the Museums and Art Galleries of the Northern Territory* 25, 111–116.

Moravec F. and Sey O. (1990) Some nematode parasites of frogs from Papua New Guinea and Australia. *Acta Societatis Zoologicae Bohemoslovacae* 54, 268–286.

Oshmarin P.G. and Demshin N.I. (1972) The helminths of domestic and wild animals in Vietnam. *Trudi Biologo-Pochyennogo Instituta* 11, 5–115.

Pichelin S., Thomas P.M. and Hutchinson M.N. (1999) A checklist of helminth parasites of Australian reptiles. *South Australian Museum Monographs Series* No. 5, 1–61.

Sachoong P. and Wongsawad C. (1997) Helminths in house lizards (Reptilia: Gekkonidae). *The Southeast Asian Journal of Tropical Medicine and Public Health.* 28, Supplement 1: 184–189.

Schmidt G.D. and Kuntz R.E. (1972) Nematode parasites of Oceanica. XIX. Report on a collection from Philippine reptiles. *Transactions of the American Microscopical Society* 91, 63–66.

Scholz T. and Ditrich O. (1991) Some trematodes of reptiles from Laos. *Folia Parasitologica* 38, 309–318.

Vanderduys E.P. and Kutt A.S. (2012) Is the Asian house gecko, *Hemidactylus frenatus*, really a threat to Australia's biodiversity? *Australian Journal of Zoology* 60, 361–367.